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# Critical Thinking Ability in the Inference Aspect in Science Learning in Elementary Schools

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**Abstract**

*This study aims to analyze the critical thinking ability in the aspect of inference in the IPAS learning process among elementary school students. This research is qualitative and employs a phenomenological design. The subjects of this study are nine fifth-grade students from SDN 01 Beruk, Karanganyar. Data collection techniques include observation, interviews, and documentation. Data validity is ensured through source and method triangulation. Data analysis is conducted through data reduction, data presentation, and verification/conclusion drawing. The results show that, in general, students have met the five indicators of the inference aspect: (1) identifying problems is evident when students can identify issues by observing events and connecting them with their existing knowledge; (2) gathering facts is evident when students can collect facts and information from various sources such as books and the internet; (3) generating alternative solutions is evident when students can produce several alternative solutions to the problems they face; (4) decision-making is evident when students consider alternatives before making a decision; and (5) providing reasons is evident when students can present relevant and logical arguments based on facts. However, there are still several aspects that need further attention to optimize this ability. The discussion of the data analysis results indicates that the critical thinking ability in the aspect of inference among elementary school students generally supports the learning process, especially in activities related to identifying facts and natural and social phenomena, as well as making rational decisions.*

## Introduction

Quality education is not just about pursuing learning outcomes in the form of grades. Various aspects of learning must also receive attention in order to develop optimally. In line with Setya et al. (2024) who stated that education aims to improve the quality of individuals and is a planned step to improve the quality of human resources through the learning process in formal educational institutions such as schools. In reality, in learning activities, teachers often direct students to memorize information, because teachers assume that memorizing will make it easier for students to get good grades in learning. In fact, currently, students are required to have 21st century skills such as critical thinking, communication, creativity, and collaboration (Faridli et al., 2024; Happ, 2013; Budiyanto et al., 2024; Maneen, 2016).

Based on the four aspects of 21st century skills, one of them is that students are required to have critical thinking skills. Critical thinking is an ability that emphasizes more on things that can be accepted by reason, namely linking old facts with newly discovered facts (Aida et al., 2019). This is supported by the statement of Surtikawati et al. (2022) which explains that critical thinking skills will stimulate students' cognitive reasoning in gaining knowledge. Frydenberg & Andone (2011) also explain that critical thinking involves the ability to analyze information, evaluate arguments, and make decisions based on evidence. Individuals who have



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critical thinking skills can identify problems, formulate relevant questions, and find effective solutions. Therefore, the development of critical thinking skills should be a major focus in modern education. This will prepare students not only for success in the academic environment, but also to face challenges in an increasingly complex and dynamic world. This ability is key to creating a generation that is able to contribute positively and effectively to society (Mahmudin, 2023; Arrington & Dwyer, 2018).

The theory of critical thinking proposed by (Ennis, 1996) through six aspects of critical thinking which are acronymed as FRISCO (Focus, Reason, Inference, Situation, Clarity, and Overview). The first aspect is Focus, this aspect emphasizes the importance of students' understanding of the problems given. Students are expected to be able to identify the core of the problem to focus their thinking. The second aspect is Reason, in this aspect students are asked to provide reasons based on relevant facts and evidence. This is important for every step in decision making and drawing conclusions, so that the decisions taken can be accounted for. The third aspect is Inference, this aspect emphasizes that students must be able to make decisions logically. Then they need to choose the right reasons to support the conclusions they make.

Next, the fourth aspect is Situation, this aspect encourages students to use all information relevant to the problem at hand. Collecting and considering the right information is essential for a comprehensive analysis. The fourth aspect is Clarity, this aspect emphasizes that students must be able to provide a more in-depth explanation of the conclusions drawn. Then, they must be able to explain the terms that appear in the problem. After that, providing examples of cases that are similar to the problem at hand will help clarify understanding. Finally, the sixth is Overview, this aspect requires students to check or recheck their entire thinking process, from start to finish. This ensures that all steps produced through the FRISCO process have been thoroughly considered (Yulinawati et al., 2022; Setiana & Purwoko, 2020).

This study focuses on examining one aspect of the six aspects of critical thinking, namely the inference aspect. The inference aspect in this study is the ability of students to identify and use the elements needed to form assumptions and consider relevant information to make decisions in solving problems. The indicators in the inference aspect that researchers take from expert opinions are presented in table 1 as follows:

Table 1. Critical Thinking Ability Indicators in Inference Aspect

| No. | Indicator | Information |
|---|---|---|
| 1 | Defining the problem | Students' ability to identify and formulate problems from the problems given |
| 2 | Digging up the facts | Students' ability to collect facts/evidence and relevant information from various sources |
| 3 | Creating alternative solutions | Students' ability to produce several alternative solutions to the problems they face |
| 4 | Make decisions | Students' ability to make the most appropriate decisions and involve in-depth consideration of each alternative |
| 5 | Giving reasons | Students' ability to choose reasons or arguments that support their decisions |

In the context of learning Natural and Social Sciences (IPAS) in elementary schools, critical thinking skills in the inference aspect are students' basic abilities to analyze facts and natural and social phenomena. This is supported by Anggraeni & Anif (2019) who stated that there are many potentials from the school environment that can be managed and utilized as learning



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resources, including the natural environment, social environment and artificial environment that can be used to develop knowledge, skills and attitudes. Then related to critical thinking skills and IPAS learning in accordance with the opinion of Rosyida et al. (2024) who explained that science learning plays an important role in shaping students to be able to develop critical, logical, creative, and innovative thinking skills. Therefore, it is important to design interactive IPAS learning, so that students can practice and develop their critical thinking skills effectively. This will prepare them to become individuals who not only understand science, but can also apply it in everyday life.

Previous research related to critical thinking skills in general was previously conducted by Widyowati & Sari (2021) who studied the critical thinking skills of junior high school students in solving HOTS problems in terms of Field Independent and Field Dependent cognitive styles showed that students with FI cognitive styles have more optimal critical thinking skills in solving HOTS problems compared to students with FD cognitive styles. Then Astiantari et al. (2022) who studied the critical thinking skills of junior high school students in solving mathematics problems in terms of the adversity quotient (AQ) in grade IX junior high school students showed the results that students with the climber type met all the FRISCO critical thinking criteria, while students with the camper and quitter types still need to be motivated to have high fighting spirit in order to have high critical thinking skills in solving mathematics problems. In addition, Rahayu & Al Hadi (2023) analyzed students' critical thinking skills in learning using PBL-Based Science E-book Media and found that the problem-based learning-based e-book media developed was able to train students' critical thinking skills. The implication of the developed e-book product is that it can be practically used by teachers in learning to train students' critical thinking skills (Ambarwati et al., 2019; Lieung et al., 2021; Aristyasari et al., 2023; Azizah & Sucahyo, 2022).

In addition to research that examines critical thinking skills in general, there is also research that examines critical thinking skills specifically in the inference aspect, such as that conducted by Pritananda (2017) who examined students' critical thinking skills in the inference aspect in solving Pythagorean theorem story problems in grade VIII junior high school students, showing that students' critical thinking skills, especially in the inference aspect, are generally classified as low. Most students still do not meet the three indicators of the inference aspect, namely questioning facts, making alternatives, and drawing conclusions. This is in line with the findings of Aprilia (2020) in a study of students' critical thinking skills based on the inference aspect in solving mathematical story problems in grade X high school students, showing that based on the inference aspect indicators studied according to Facione, namely, at the stage of questioning facts, the stage of making alternative solutions and the last is drawing conclusions. The results of the study showed that many students succeeded in passing the stages in the aspect of questioning facts. Meanwhile, at the stage of making alternative solutions and drawing conclusions, students still had difficulty. Students still could not conclude whether there were other alternatives that could be done, they were only fixated on one alternative solution.

Based on previous research, it was found that research has been conducted related to students' critical thinking skills at elementary, junior high, and high school levels. However, research that analyzes critical thinking skills in the inference aspect is still limited. There are several studies related to critical thinking skills specifically in the inference aspect, but these studies were conducted at the junior high school level in the Mathematics learning content. This shows that research related to critical thinking skills in the inference aspect at the elementary school level in the Natural and Social Sciences (IPAS) learning content is still rare, so this requires further analysis. So that further research was conducted to explore more deeply the critical



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thinking skills focused on the inference aspect at the elementary school level, especially in the Natural and Social Sciences (IPAS) learning content.

The aim of this study is to analyze critical thinking skills in the inference aspect of science learning in elementary school students using indicators including: (1) determining problems, (2) exploring facts, (3) creating alternative solutions, (4) making decisions, and (5) providing reasons.

## Methods

The approach in this study is qualitative with a phenomenological design. This study was conducted at SDN 01 Beruk, Jatiyoso District, Karanganyar Regency, then made 9 students of grade V of SDN 01 Beruk as research subjects. The data collection method in this study used 3 techniques, namely observation, interviews, and documentation. After conducting observations on learning, interviews were then conducted with research subjects. Interviews in this study were conducted by grade V students represented by 6 students. Interviews in this study were used to obtain a more in-depth analysis, clarify and confirm the results of observations based on indicators of critical thinking skills that may not have been revealed in observations in learning. Data validity testing used triangulation techniques from the results of the data obtained. Data were analyzed through stages as described by Miles and Huberman (1984), namely, data reduction, data presentation, and verification/drawing conclusions. The indicators used related to critical thinking skills in the inference aspect in students' decision-making skills include: (1) determining problems, (2) exploring facts, (3) creating alternative solutions, (4) making decisions, and (5) providing reasons.

## Results and Discussion

The critical thinking ability analyzed in this study is the critical thinking ability of the inference aspect of elementary school students with the following indicators, namely: (1) determining problems, (2) exploring facts, (3) creating alternative solutions, (4) making decisions, and (5) providing reasons. After conducting research on the critical thinking ability of the inference aspect in science learning in elementary schools, data was obtained from the results of observations based on indicators of critical thinking ability of the inference aspect. The results of the observations are presented in table 2 as follows:

Table 2. Results of Observations on Critical Thinking Skills in the Inference Aspect

| No | Observed Indicators | Observation result |
|---|---|---|
| 1 | Defining the Problem | Students are able to identify problems by reading the reading “Impact of Jlantah Dam Construction” given by the teacher. They are able to connect the phenomena that occur, such as changes in the ecosystem due to the construction of Jlantah Dam, with the knowledge they have learned, although some students still need guidance to sharpen their ability to formulate problems to be more specific and focused. |
| 2 | Digging Up the Facts | Students are able to utilize various sources of information, both from textbooks related to ecosystems and environmental impacts, and from online sources such as Google and YouTube. However, there needs to be improvement in |



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| | | |
|---|---|---|
| | | terms of the accuracy and precision of the facts/evidence and information collected. Some students still need to learn more about distinguishing between facts and opinions. |
| 3 | Creating Alternative Solutions | Students are able to formulate various alternative solutions. For example, they consider solutions such as creating migration routes for animals, building fences around the project area, building new habitats, or creating a zoo in an effort to preserve the environment. Some students demonstrate innovative thinking, while others tend to stick to common and less innovative solutions. |
| 4 | Make decisions | In making decisions, students have shown positive progress. They can consider several alternatives before making a decision. In this case, students choose the solution to create a zoo or animal breeding. However, some decisions taken are not fully based on in-depth analysis and comprehensive consideration. |
| 5 | Giving Reasons | Students are able to choose reasons that support their decisions. They are able to provide relevant and logical arguments. In this case, students choose to create a zoo or animal breeding ground, because in addition to its main purpose to preserve langurs and pythons, it can also be a tourist attraction for residents around the Jlantah Dam. However, some students still need guidance in evaluating the strengths and weaknesses of the reasons they choose. |

In addition to the observation results, interviews were also conducted to strengthen the observation results and also to analyze in more depth several things that were not visible in the learning observations. The interview results are presented in table 3 as follows:

Table 3. Results of the Critical Thinking Skills Interview for the Inference Aspect

| No | Indicators Asked | Informant | Interview Results | Result Description |
|---|---|---|---|---|
| 1 | Defining the Problem | GL, CK, TQ, | *"We observed the reading given by the teacher, then connected it to the things we knew. We determined the problem was that the construction of the Jlantah Dam had affected the natural habitat of animals, especially langurs and pythons, which then moved into the residential area."* | Students are able to identify problems well. |



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|---|---|---|---|---|
| 2 | Digging Up the Facts | MF, GL, FA | "We searched for facts using various sources of information, including textbooks on ecosystems, then searched for articles on Google and videos on YouTube." | Students are able to collect facts/evidence and necessary information using various sources. |
| 3 | Creating Alternative Solutions | TQ, CK, MF | "We are making several possible solutions, such as creating migration routes for animals, building fences around the project area, building new habitats, or creating a zoo." | Students create several alternative solutions to problems. |
| 4 | Make decisions | GL, FA, BA | *"After discussing, we chose the solution of creating a zoo or an animal enclosure such as langurs and pythons to preserve these animals."* | Students consider various alternatives before making a decision. |
| 5 | Giving Reasons | GL, CK, BA | *"We chose this decision because it has greater benefits, in addition to preserving the langurs and pythons, it is also a tourist spot for residents around the Jlantah Dam."* | Students are able to formulate relevant and logical arguments based on facts/evidence. |

Based on Table 2 related to the observation results then reinforced by the interview results as presented in Table 3, it was obtained that 1) The indicator of determining the problem, shows that students are able to identify problems by observing events and connecting them with the knowledge they have, but still need guidance to determine the problem more specifically. 2) The indicator of digging up facts, shows that students are able to collect facts and information from various sources, such as books and the internet (Google and YouTube) to understand the cause of the problem, but need to improve in accuracy and the difference between facts and opinions. 3) The indicator of alternative solutions, reveals that students can produce several alternative solutions to solve the problems faced, but the quality and creativity vary. Some solutions are innovative, while others tend to be general. 4) The indicator of making decisions, shows that there is positive progress in decision making. Students consider alternatives before making decisions, but some decisions are still influenced by personal preferences, which reduces objectivity. 5) The indicator of giving reasons, shows that students are able to provide relevant and logical arguments based on facts, explaining that decisions are made based on greater positive impacts and smaller risks, but some still need guidance in evaluating the strengths and weaknesses of the reasons chosen.

The results of the observations and interviews were also strengthened by the documentation obtained in the form of a class V Science teaching module on ecosystem changes that applies the Problem Based Learning (PBL) learning method based on Ethnoscience. Critical thinking skills in the inference aspect in science learning in elementary schools with several indicators as described below:



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**Determine the problem**

In the indicator of determining the problem, students are able to identify problems by observing events and connecting them with the knowledge they have. This can be seen when students are able to identify problems by reading the reading "Impact of Jlantah Dam Construction" given by the teacher. They can connect the phenomena that occur, such as changes in the ecosystem due to the construction of the Jlantah Dam, with the knowledge they have learned. For example, they realize that dam construction can disrupt the natural habitat of animals, which leads to shifts in animal behavior such as langurs and pythons.

Students understand that the natural habitats of animals such as langurs and pythons are disturbed by development, forcing them to seek new homes in residential areas. They are also aware of the consequences of moving these animals into residential areas, such as the potential for unwanted interactions between the animals and local residents.

This is in line with Wasahua's (2021) research which found that to think critically, a person must read critically, apply critical thinking skills such as observing, connecting texts with their context, evaluating texts in terms of logic and credibility, reflecting on the content of the text with one's own opinion, comparing one text with other similar texts.

Thus, students who are able to understand the context and substance by reading critically, are then able to identify and formulate problems, this shows that students fulfill the indicators for determining problems.

**Digging Up Facts**

In the indicator of digging for facts, students are able to collect facts and information from various sources. This can be seen when they work together in groups to find relevant evidence and data related to the problem of ecosystem changes due to the construction of the Jlantah Dam. In this process, students utilize various sources of information, both from textbooks related to ecosystems and environmental impacts, as well as from online sources such as Google and YouTube. They search for articles and videos that explain the impact of the construction of a dam on animal habitats, especially langurs and pythons.

This is in line with Pritananda (2017) who stated that to measure students' critical thinking skills in the inference aspect in this indicator, students' ability to write down information obtained from the given problem will be seen. Thus, by paying attention to how students write and present facts and information obtained from various sources according to the given problem. This shows that students meet the indicator of digging up facts.

**Create Alternative Solutions**

In the indicator of creating alternative solutions, students can produce several alternative solutions to solve the problems faced. This can be seen when they discuss in groups to formulate possible solutions related to the problem of ecosystem changes due to the construction of the Jlantah Dam. Students are involved in active discussions, sharing their ideas and views on possible solutions. This reflects their ability to think critically and consider various approaches to solving problems. In formulating solutions, students show creativity by proposing various alternatives. For example, they consider solutions such as creating migration routes for animals, building fences around the project area, building new habitats, or creating zoos in conservation efforts.

This is in line with Aprilia (2020) who explained that to measure students' critical thinking skills in the inference aspect, it will be seen how students create an alternative or solution that is in accordance with the information obtained. Thus, students who are able to create alternative



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solutions that are relevant to the information obtained by involving a logical and practical solution search process, this shows that students meet the indicators for creating alternative solutions.

**Making Decisions**

In the decision-making indicator, there is positive progress in decision-making. This can be seen during the discussion process, they actively analyze various proposed solutions to overcome the problem of ecosystem changes due to dam construction, which causes langurs and pythons to move to the residential area around the Jlantah Dam. They analyze each solution from various perspectives. In this case, students choose the solution to create a zoo or animal breeding.

Pritananda (2017) also expressed the same thing, namely that students' ability to determine the most correct final conclusion from various alternative problem solving is based on previously obtained information. Thus, students who are able to conclude correctly based on the information obtained, they do not only see the solution superficially, but also consider various aspects and implications of the decisions to be taken. This shows that students meet the indicators for making decisions.

**Giving Reasons**

In the indicator of providing reasons, students are able to provide relevant and logical arguments based on facts, explaining that decisions are made based on greater positive impacts and smaller risks. This can be seen during the decision-making process related to solutions to overcome the problem of ecosystem change due to the construction of the Jlantah Dam, they are able to explain the reasons behind the choices they make in a structured way. In this case, students choose to create a zoo or animal breeding, because in addition to its main purpose of preserving langurs and pythons, it can also be a tourist attraction for residents around the Jlantah Dam.

The above shows that students are able to put forward logical arguments, explaining why the chosen solution has a greater positive impact than other alternatives. They explained that the chosen solution is not only effective in solving the problem, but can also be used to become a tourist attraction that is beneficial for the managers and the community around the Jlantah Dam.

This is in line with Wasahua (2021) who explains that a student's reasons/arguments must use supporting evidence to draw a conclusion. Thus, the use of supporting evidence in students' arguments is key to drawing the right conclusions. Strong evidence not only strengthens arguments but also shows students' ability to evaluate information objectively and to analyze and construct arguments based on valid data. This shows that students meet the indicators of creating alternative solutions and providing reasons.

The results of the documentation study to strengthen the results of interviews and observations in the form of Teaching Modules in the learning of science for class V SDN 01 Beruk, Teachers have implemented the Problem Based Learning (PBL) learning model based on Ethnoscience which can support the instillation of students' critical thinking skills. This is in line with research conducted by Nashiroh et al. (2024) which found that the application of the Problem Based Learning model has a positive impact on learning outcomes and encourages students to solve problems in improving students' critical thinking skills.

The same thing was also expressed by Sari et al. (2021) that ethnoscience-based learning encourages students to think critically through mental activities, therefore the use of ethnoscience-based science learning can support students to develop in responding to the information received by considering all aspects related to the information. In addition, Nur et



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al. (2023) also revealed that there was an influence of the application of the PBL learning model with an ethnoscience approach on improving students' critical thinking skills.

Based on the above research, it can be concluded that the Problem Based Learning (PBL) learning model based on Ethnoscience in the Natural and Social Sciences (IPAS) subject matter can improve the critical thinking skills of elementary school students in the inference aspect. The contents of the conclusion should be in the form of answers to questions and research objectives. The conclusion is presented in one paragraph, not points, and is not expressed in statistical sentences. If necessary, at the end of the conclusion, things that will be done related to further ideas from the research can also be written.

## Conclusion

Based on the results of research and discussion related to critical thinking skills in the inference aspect in elementary school science learning that have been explained previously. The results of the study show that, in general, students have met the five indicators of the inference aspect, namely: (1) determining problems is seen when students are able to identify problems by observing events and connecting them with the knowledge they have, (2) exploring facts is seen when students are able to collect facts and information from various sources, such as books and the internet, (3) creating alternative solutions is seen when students can produce several alternative solutions to solve the problems faced, (4) making decisions is seen when students consider alternatives before making decisions, and (5) providing reasons is seen when students are able to provide relevant and logical arguments based on facts.

To optimize students' critical thinking skills in the inference aspect in elementary school science learning, it is recommended to apply learning methods that include group discussion activities and case studies such as the Problem Based Learning (PBL) learning model based on Ethnoscience. Thus, it can be concluded that the critical thinking skills of elementary school students in the inference aspect generally support the learning process, especially in activities to identify facts and natural and social phenomena, and make rational decisions.

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